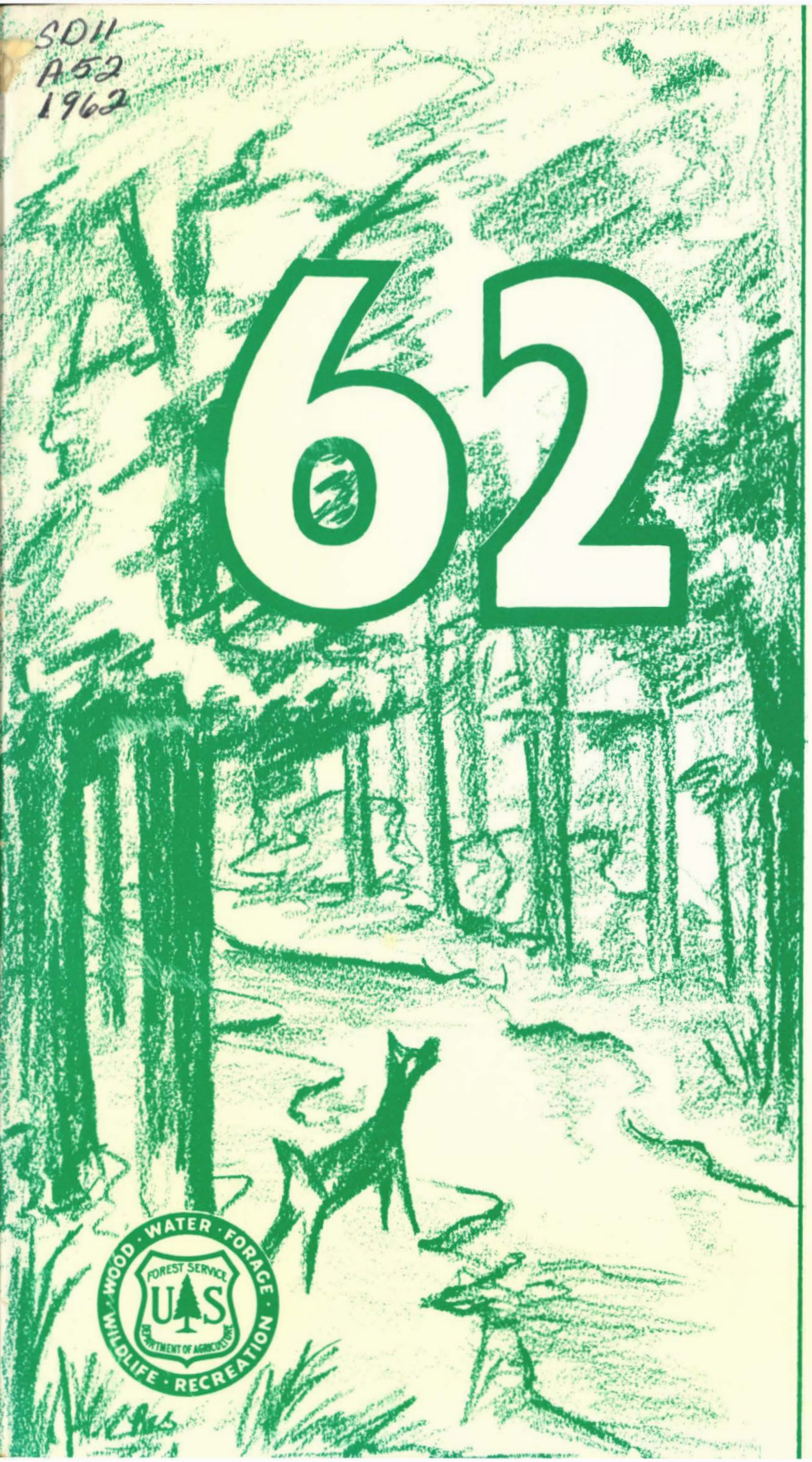
SD11
A52
1962



SD11
A52
1962

in review

1962 Annual Report — Central States Forest Experiment Station
U.S. DEPARTMENT OF AGRICULTURE — FOREST SERVICE
Columbus, Ohio R. D. Lane, Director

LIBRARY COPY
ROCKY MT. FOREST & RANGE
EXPERIMENT STATION

'62 IN REVIEW

1962 was another busy year at the Central States Forest Experiment Station — a year in which we continued to progress in developing the science of protecting, growing, using, and marketing the multiple forest resources of the Central States. We would like to share the highlights of this progress with you during the next few minutes.

This year, instead of discussing our work with you we have pictured it for you. We have selected a group of photos that we hope will transport you briefly to our forestry research laboratories, both indoors and outdoors, and help you visualize the work we are doing. While trying to give you a general view, we have necessarily concentrated on research activities and results that lend themselves to illustration. However, much of what you will see here as well as research that we could not include is discussed in detail in our publications for 1962. These are listed in the back beginning on page 31. If you've missed any of them we would be glad to fill your requests as long as the supply lasts.

RICHARD D. LANE
Director

CONTENTS

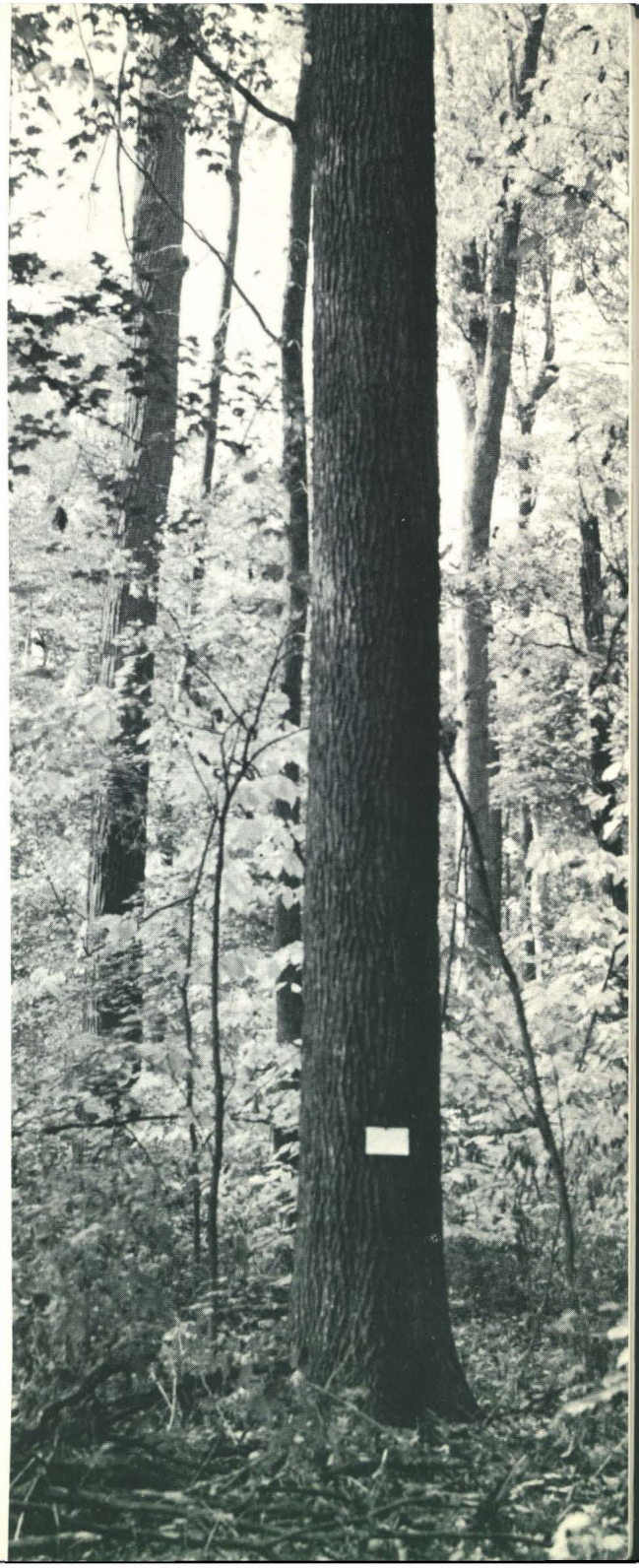
Forest Management	page one
Forest Economics	page nine
Forest Diseases	page twelve
Forest Insects	page fifteen
Forest Fire	page eighteen
Forest Products Utilization	page twenty
Range Management	page twenty-three
Watershed Management	page twenty-six
Recreation and Wildlife	page twenty-nine
1962 Publications	page thirty-one

FOREST MANAGEMENT

During the year we made progress in many major aspects of forest management research. Site preparation studies were concentrated on brushy upland old fields and areas recently harvested and recently cutover bottomlands subject to rank herbaceous weed growth. Studies on the influence of soil micro-organisms on hardwood development were continued to determine the extent to which our high-value species depend upon some soil fungi for survival and growth. This information is needed to work out thoroughly the silvics of important hardwood species. The results of these studies may also help solve hardwood planting problems on old fields.

Active work in tree improvement consists of seed source studies on black walnut; yellow-poplar; eastern cottonwood; and white, loblolly, and shortleaf pines; and studies of wood quality as related to environment and heredity.

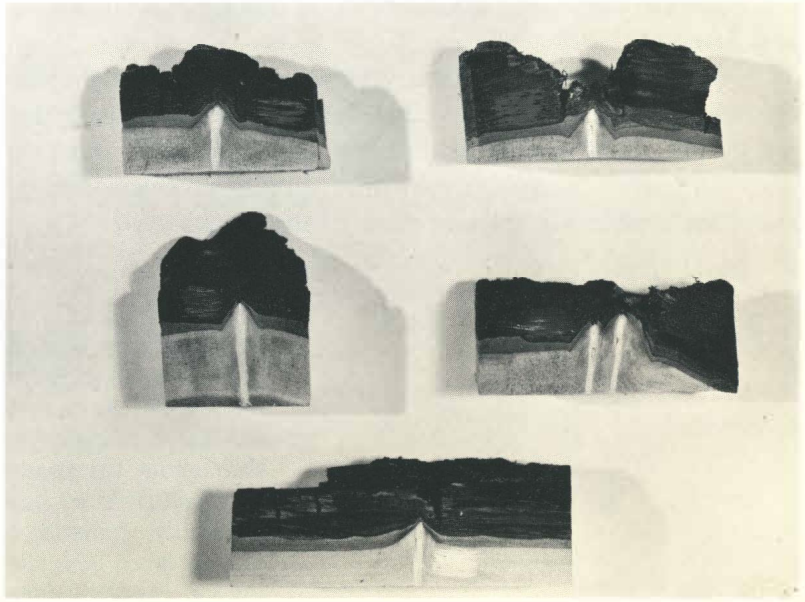
We expanded our work in hardwood stand density control by sites, age classes, and types. Our chief aim in making these studies is to find the proper stand density at different stages of forest stand development that will assure maximum growth of quality products. Site and growth-and-yield studies are integral parts of the work.



In cooperation with the American Walnut Manufacturers' Association and the state foresters of the Region, we have been searching for and collecting seed from superior black walnut trees throughout the species' range. The progeny of 40 select trees we have found will be planted in Kentucky, Indiana, Iowa, and Missouri. The tree pictured here shows the kind we are looking for. It is 28 inches in diameter, 136 feet tall, and has a clear length of 57 feet. It is located in a farm woodland in Fountain County, Indiana.

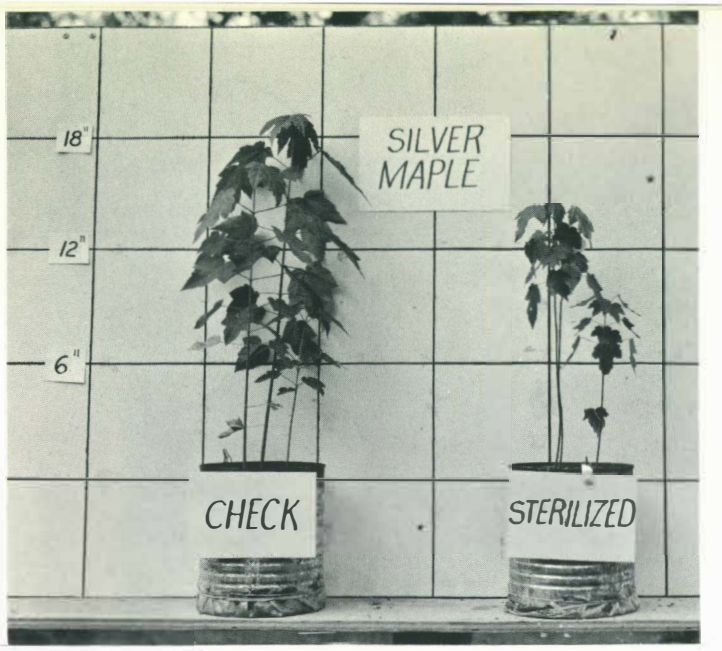
Sometimes it is impossible to preserve a superior tree as a source of genetic material for breeding and selection studies. Then we preserve the genotype by grafting cuttings from the selected tree to other rootstocks.

The job of finding genetically superior black walnut trees is complicated by the fact that suppressed buds, which form pin knots, are not always visible on the surface of the trunk. Buds such as those shown in these cross sections grow within the tree, leaving behind small imbedded knots.



We need to understand the processes of flower and seed development so we can develop new races of trees through inbreeding and hybridization. One of the problems with some of the oaks is low acorn production. This enlarged cross section of a female flower of white oak shows that only one (arrow) of the six ovules has been fertilized and will develop into an acorn.

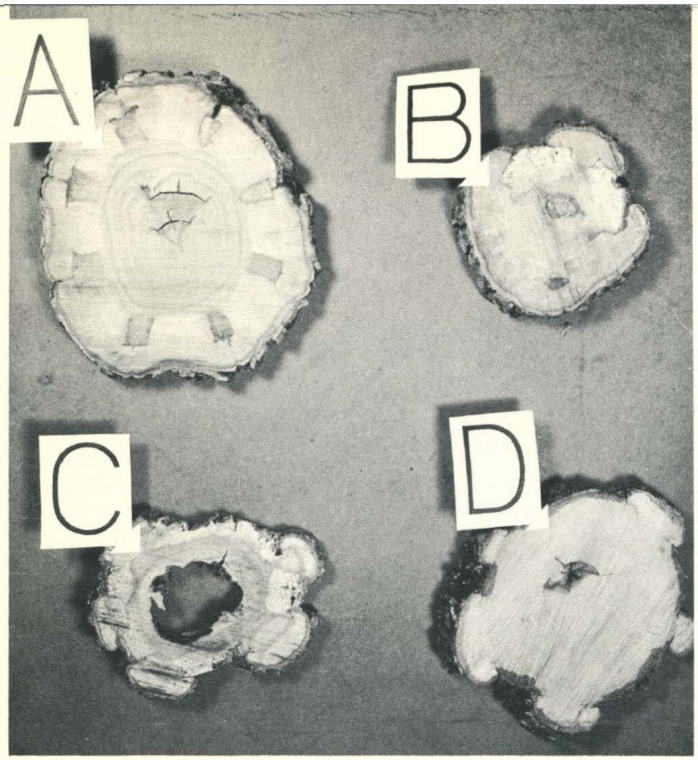
Collections from these traps tell us what is happening to the white oak acorn crop. This tree lost a tremendous number of female flowers during the pollination period; consequently the acorn crop was small.



Our basic work with endotrophic mycorrhiza-hardwood relations continues at Bedford, Indiana. Earlier studies were restricted to yellow-poplar but this year we included other species. Silver maple seedlings shown grown in sterilized soil weighed less than one-third as much as those grown in soil containing mycorrhiza.

Baskets serve as seed traps in a flooded pin oak flat in Missouri. The Station, the University of Missouri, and the Missouri Conservation Commission are studying tree growth and acorn production on such land with an eye toward managing it for timber and/or wildfowl.

To bolster the production and quality of hardwood planting stock we are cooperating with the Indiana Division of Forestry in establishing this yellow-poplar seed production area. (*Photo courtesy Indiana Department of Conservation.*)



Getting rid of undesirable trees is a major problem in central hardwood forests. Cross sections of boles of trees treated with 2,4,5-T by the injection method show little lateral transfer of the herbicide 2 years after treatment. All four of the trees sampled to obtain the sections shown here were alive when cut. This means that herbicide must be applied completely around the circumference of the tree to assure a kill. The species are: (A) white oak, (B) black oak, (C) southern red oak, and (D) hickory.

Pruning hardwoods is often necessary to produce high-quality logs. A pruning study involving five species and 300 trees at the Kaskaskia Experimental Forest in Illinois shows that pruning time per tree varies with species, tree size, and height of pruning. Actual pruning time to 17 feet ranged from 1.4 man-minutes per tree for yellow-poplar to 5.2 man-minutes for scarlet oak. Pruning to 25 feet generally required more than three times as long as pruning to 17 feet.

Weed control is receiving attention in our plantation studies in Iowa. A recent experiment showed that either a commercial herbicide (Simazine) or black polyethylene film applied as a mulch would very effectively control weeds for at least a year in a new pine plantation.

An alfalfa-brome grass pasture was prepared for tree planting by plowing and disking. White pine seedlings were planted in April and then Simazine 80W was sprayed over the assigned plots (between the stakes in the foreground) and film applied to the plot at the left.

Ten weeks later the treated plots looked like this (mulched plot, hidden from view behind weeds that developed on untreated strip, looks much like these two). Untreated check plot is at right.

We are trying to find the right density for hardwood stands — one at which the trees will grow fast yet produce high-quality timber. Take pole-size white oak for example:

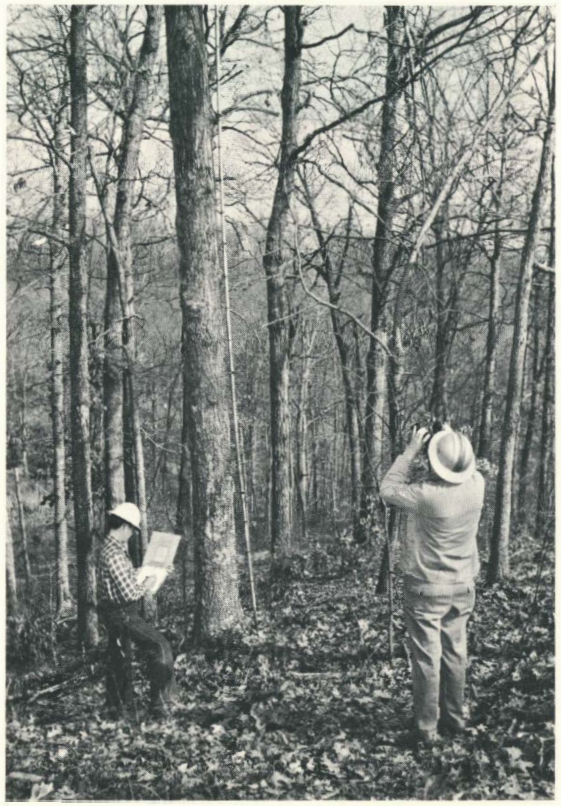
This stand is about right. — 70 percent stocking. Our studies show that intermediate stocking yields the greatest volume of high-quality timber in the shortest time.

This stand is too dense. — 100 percent stocking. In such a stand quality is usually high but growth is slow.

This stand is too sparse. — 30 percent stocking. In this open stand trees grow fast, but quality is likely to be poor unless trees are pruned.

Much of modern forestry depends upon accurate measurements: tree diameter, height, growth, taper, defects, and so on. Forest mensuration has, in fact, almost become a science in itself and we are constantly trying to develop better and more precise ways to measure trees and predict what they will do.

This research team is "mapping" the defects on an oak tree. The researchers will return in the future to find out how the silvicultural treatment of the stand has affected the "face" of this tree.



Here a mensurationist measures the effects of stand density on the growth, form, and taper of a shortleaf pine.

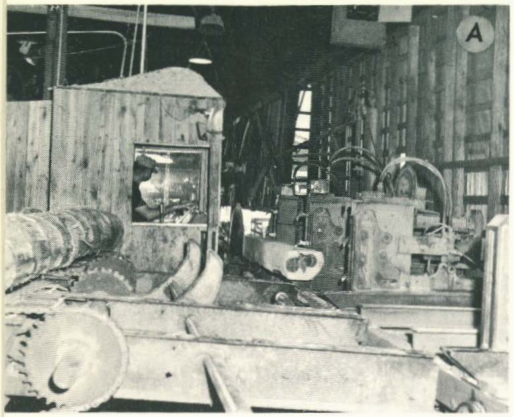
FOREST ECONOMICS

In our forest economics research we are seeking ways to help forest-land owners and timber operators lower the cost and increase the efficiency of producing, manufacturing, and marketing timber.

At our main office in Columbus, Ohio, we compile and report information on location, volume, growth, and quality of our forest resources, and on production and use of timber by the forest industries. Here too, we are studying the business aspects of managing small forests.

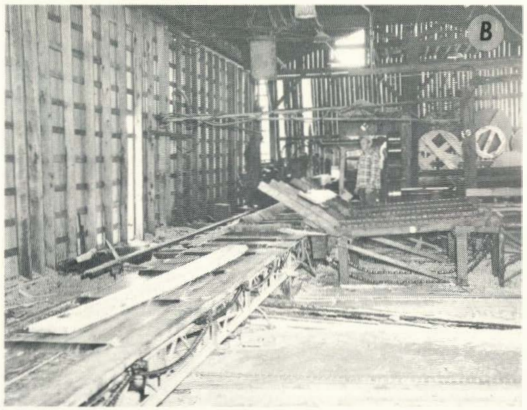
Researchers at our Berea, Kentucky, office are working to develop more efficient and profitable means of processing and marketing timber products. While at our Carbondale, Illinois, office our research is concerned with ways to expand markets for timber of low quality and little-used species.

Station scientist timing each pass of the log through the headsaw at a Kentucky mill, a part of our sawmill efficiency study. Time necessary to saw a log into lumber is affected by log size, log grade, and sawing technique.



Lumber is the principal product obtained from forest land in the Central States. However, many sawmills have gone out of business during the past decade because of low profits. Research we now have underway seeks to pinpoint some of the lumber producer's problems and to suggest solutions for them.

Is mechanization the answer to increased mill efficiency? In the past, substitution of machines for hand labor progressed slowly at hardwood sawmills. Now the increasing use of labor savers such as: (A) live log decks and log turners, (B) live rolls, and (C) log barkers promises to reduce the costs of processing.



Recent studies indicate that up to 30 percent of the lumber delivered to some furniture plants is mismanufactured. However, a circular sawmill can produce high-quality, accurately sawed lumber if the saw is properly adjusted and skillfully run. Quality control studies will provide the operator guidelines for increasing product quality.

The current forest survey of Missouri is completed. Results so far show that sustained efforts to reduce fires, overgrazing, and poor cutting practices are gradually bringing the forests up to their potential productivity. Since 1947, the State's growing-stock volume has increased more than 25 percent and sawtimber-size stands have doubled in area. Despite the killing drought of the late 1950's, Missouri's timber is growing at a rate of over 5 percent annually. Less than 2 percent of the growing stock is being cut each year for forest products, leaving a net volume increase of more than 3 percent.

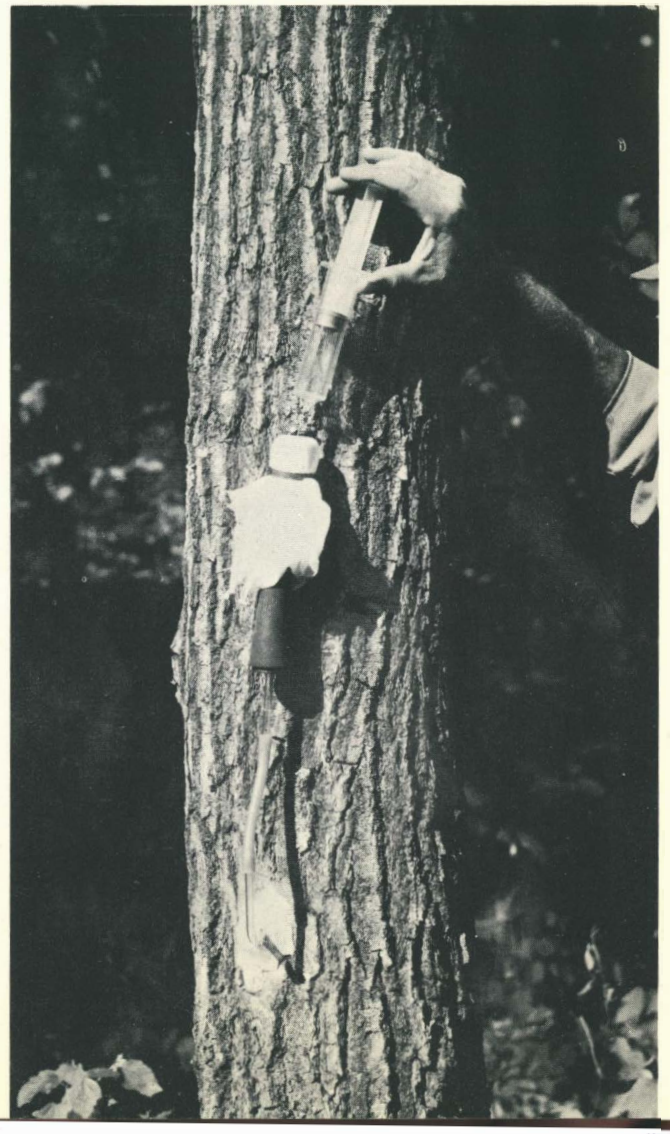
A special canvass of the Region's charcoal industry, conducted as part of a nationwide survey, revealed that Central States plants produced over 84,000 tons of charcoal in 1961, almost three times as much as in 1956. Missouri accounted for more than three-fourths of the Region's charcoal plants, kilns, and production. About 80 percent of the production was used to manufacture briquettes.

Each year we contact the wood-using pulpmills of the Region to keep abreast of changes in pulpwood production and consumption. In 1961, Central States pulpwood production and mill consumption continued to climb and both went over the half-million-cord mark. Ohio led the Central States in production by accounting for 47 percent of the total.

FOREST DISEASES

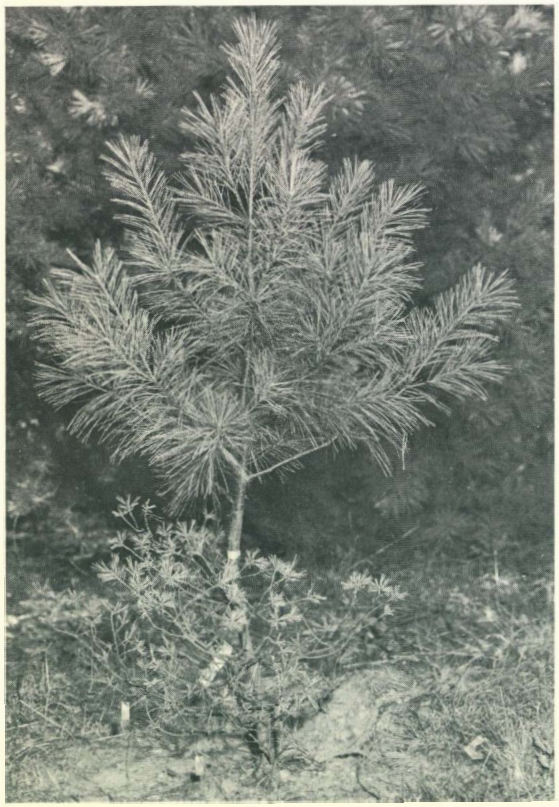
In 1962 we strengthened forest disease research at our Delaware, Ohio, laboratory by starting basic studies on the biochemistry of the oak wilt disease. We have developed new methods of sap extraction to permit the critical analysis of metabolites by advanced laboratory techniques. We pushed ahead also our other work on oak wilt. This includes determination of the incubation period of the oak wilt fungus in trees inoculated with different spore loads, a study of the importance of the small oak bark beetle in natural transmission, and an evaluation of a simple field method of eradicating the oak wilt fungus from logs destined for export.

Research on pine plantation diseases, particularly chlorotic dwarf of white pine, is yielding information on the causal relations of these diseases. And studies to evaluate the effectiveness of chemical stump treatments for the control of *Fomes annosus* root rot are progressing.



Black oak trees were inoculated in the bole or crown with spore dosages of the oak wilt fungus ranging from 10 to 100,000,000 spores per tree to find the length of the incubation period. This information will help us in developing control methods. Incubation periods were slightly longer for crown-inoculated trees than for bole-inoculated trees but symptom expression was identical. The "usual" incubation period for trees of the red oak group appears to be 6 to 8 weeks. Symptom expression appeared in the second growing season after inoculation in only 4 percent of the diseased trees.

Field observations and defoliation, grafting, and nutrition experiments indicate that the symptoms of chlorotic dwarf result from direct damage to the needles. This suggested air pollution as a possible cause. To investigate this possibility, we placed plastic chambers provided with either charcoal or Fiberglas filters over infected plantation trees to prevent the entry of air pollutants and fungus spores. Thus far current needles on trees in the chambers have not developed chlorotic dwarf symptoms, while current needles of exposed diseased trees have shown characteristic symptoms.



Side grafts made between 5-year-old plantation-grown healthy and diseased white pines in 1959 failed to demonstrate that chlorotic dwarf of eastern white pine is caused by a virus or nutritional imbalances. Healthy scions from both Scotch and white pines generally retain their vigor when grafted to diseased white pines and diseased scions from white pines usually remain symptomatic on healthy Scotch and white pine. In this illustration a healthy scion made in 1959 has far outgrown the diseased stock — yet the stock continues to decline, thus suggesting that damaged roots are not likely involved.

We are studying progress of *Fomes annosus* under different site and stand conditions, such as this infected shortleaf pine stand.

To study the effectiveness of different materials in controlling *Fomes annosus* in shortleaf pine plantations in Missouri, we applied chemicals to freshly cut stumps and then sprayed them with a heavy spore suspension of *F. annosus*. Stumps were cut high so that discs could be cut from them for examination in the laboratory for signs of infection.

Aftermath of fire — the fungus that caused the decay in this white oak gained entrance through the fire scar at the base of the tree. We are now determining the decay losses, establishing the identity, frequency, and severity of the decay organisms, and evaluating the factors associated with decay processes in the oak-hickory forests of the Central States.

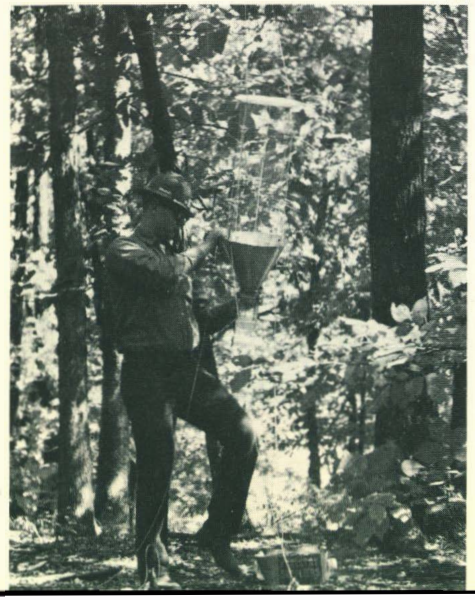
FOREST INSECTS

Our forest insect research is designed to provide basic information about the life histories, natural enemies, and the influence of forest-stand manipulation on forest insect pests. Such information reveals possible weak points in the pest armor when the insects are most vulnerable to either natural or artificial controls.

In the field of insect biology and ecology we are studying forest insect population dynamics (especially for borers in standing timber, acorn weevils, pine sawflies, and tuliptree scale) as affected by geographic location, stand density, stand composition, aspect, slope, and soil type. Our research in insect physiology and toxicology includes the behavior of insect pests as individuals and groups considering such things as feeding, light responses, chemical attractants, chemical feeding deterrents, repellents, and toxicants. In the biological-control and disease-vectors field we are working with resistant strains of trees, sterilization of insects with radiation or chemicals, the effect of parasites from Europe on the pine shoot moth, and the insects associated with oak wilt disease.

On the theory that the oak wilt fungus may be transported by insects, we are attempting to isolate and identify potential carriers in the insect population of an oak-wilt infected stand.

Our research on Dutch elm disease has taken a new turn. Now we are working on the theory that elm trees contain some attractant material or feeding stimulant that affects the smaller European bark beetle (carrier of the disease). If this is true, we may be able to find a way to counteract this attractiveness by the use of tree injections or systemics.



Insect flight traps suspended at various heights in an oak forest provide information regarding the vertical distribution of flying insects in our search for an insect vector of oak wilt.

This gigantic canvas funnel suspended within a group of oak trees treated with an extremely potent systemic catches the dead insects that have attacked or come in contact with treated trees. By studying the biology of the species collected we hope to discover whether any of these insects carry oak wilt.

We are still searching for a biological control for the locust borer.

This black locust bolt, heavily infested with eggs of the locust borer, was suspended in a young locust plantation to attract egg parasites which may serve to control the insect.

The black locust bolt and 50 pairs of adult borers enclosed in this coarse-screen cage serve as bait to attract and trap small parasitic flies and wasps.

At our Forest Insect Laboratory near Delaware, Ohio, a Forest Service scientist is pursuing still another possible way to control the locust borer: feeding the insects a chemical that will prevent egg laying or hatching.

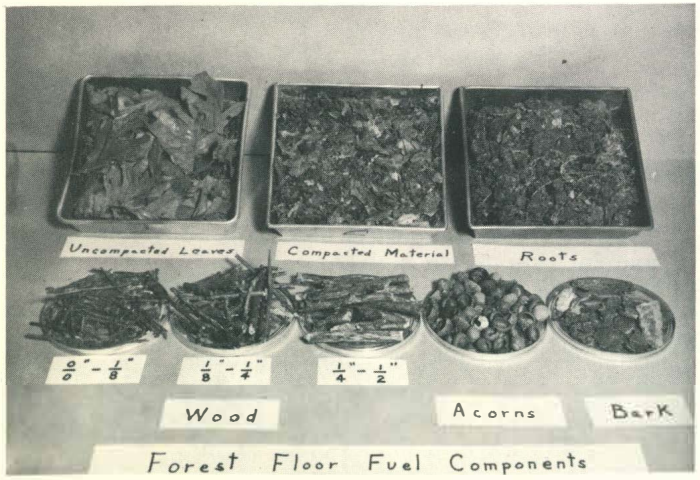
FOREST FIRE

The Station's fire research is done in Missouri where major emphasis is on forest fuels. Here, hardwood and pine forest-floor fuels, pine-crown fuels, and dead woody fuels resulting from stand improvement operations are being studied. Our objective is to identify fuel characteristics that cause differences in fire behavior and affect fire danger. We are also helping to develop and evaluate the Forest Service Unified Fire Danger Rating System, with particular reference to its application in the Central Hardwood Region. We also have some work underway on the effects of fire.

The forest-floor fuels in a hardwood stand greatly influence the character of the fire that would burn there.

A small sample of this fuel is being taken by cutting around a sampling cylinder. A number of these small samples are combined for a sample large enough to represent a specific area.

Sampling cylinder has been removed, and fuel-depth measurements are being taken.

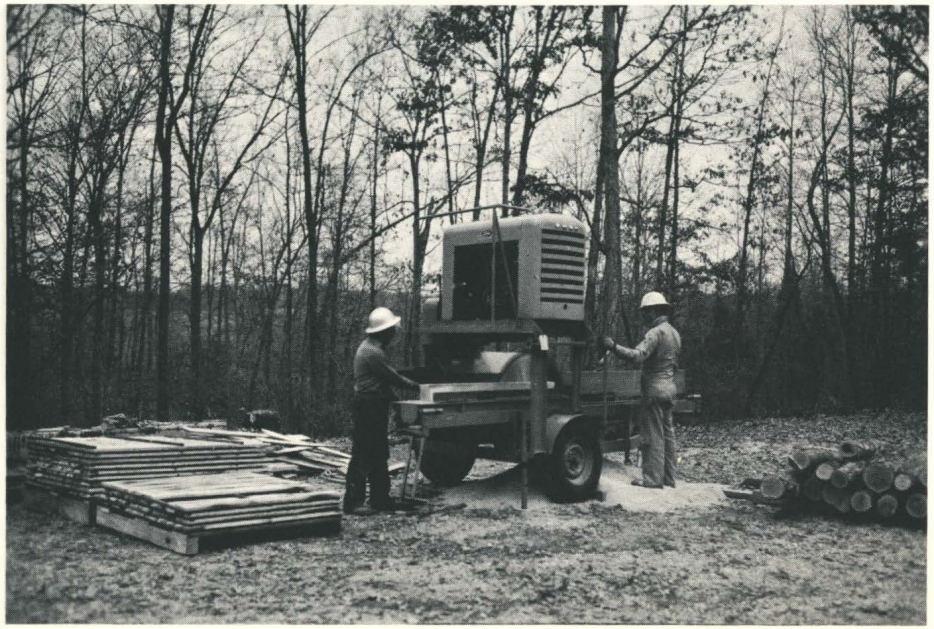


The fuel samples are separated in the laboratory into components and ovendry weight of each component is determined.

FOREST PRODUCTS UTILIZATION

Emphasis was continued in 1962 on finding better methods for harvesting our native tree species and new and expanded uses for them.

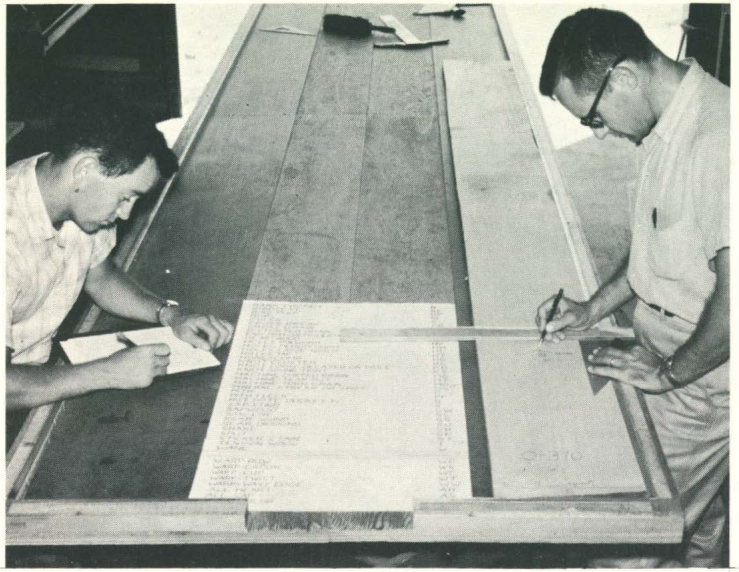
A greater than usual amount of time was spent this year in assisting industries and taking results of research to potential users. This was accomplished through consultations with individual industries and strengthening of our cooperative program with the Extension Foresters and State Foresters. For instance, on a trial basis, we began distributing brief notes on forest product utilization research results and industry developments to the State agencies and National Forests. The notes contain information of current interest and value in promoting increased and better use of native woods.



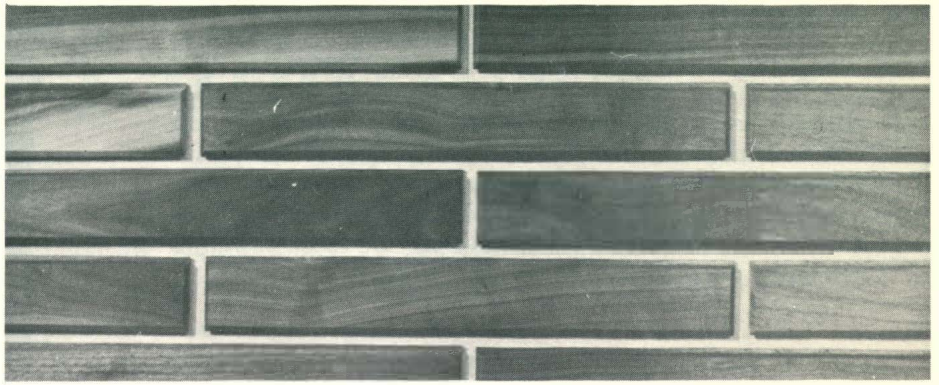
Bolter saws are frequently used at permanent sites to cut squares and other dimension stock from short bolts of woods. We believe that a highly portable bolter saw can play an important part in an integrated logging operation. We are undertaking studies of its use at the Kaskaskia Experimental Forest to investigate these possibilities.

As a result of our study of hickory for stadium seats, begun in 1953, Southern Illinois University has decided to replace all seats in its stadium at Carbondale with hickory. Six hundred fifty new hickory seats were installed during the summer of 1962. Slats for these seats were produced in our Wood Products Pilot Plant to study production methods and costs. Slats for 1,000 additional new seats will be produced by a local industry for installation in 1963.

Experimental wood pallets in use at an apple-processing plant. We made 90 pallets using different combinations of green and air-dry oak lumber for deckboards and stringers to determine the effect of initial moisture content of pallet parts on the serviceability of the pallets. During the 3 years these pallets have been in use we have found that for best service stringers could be either green or air-dry but deckboards should be dry.



Scientists at our Wood Products Pilot Plant are determining the type and location of defects in the top five grades of 4/4 hard maple lumber. We have collected such information from about 12,000 board feet of lumber for the cutting-yield study we are making in cooperation with the Forest Products Laboratory. This information will be transferred to data cards and processed in a computer to investigate the possibility of predicting the yield of cuttings from different grades of lumber by electronic data processing. Later, the lumber will be cut up in our Pilot Plant to check computer predictions.



Our work on wood brick wall tiles and strip paneling continues. A new twist developed this year is the bonding of dark-colored, individual tiles to a light-colored background with ¼-inch spacing. This gives a more realistic appearance by enhancing the mortar effect and adding depth.

Here we are measuring the moisture content of hardwood construction bricks in an experimental wall at our Wood Products Pilot Plant. Moisture probes have been placed at different depths on both the interior and exterior faces of the bricks to measure the variation in moisture content from the outside to the inside face. Thermocouples and moisture probes on each side of the wall, and in the joints between bricks, are connected to the switch panel and instruments on the left. These and other measurements are made to study behavior of the wall panel under changing atmospheric conditions. Bags of sand are used to produce a simulated roof load on the top of the wall.

RANGE MANAGEMENT

Livestock production is an important part of the agricultural economy of the oak-hickory-little bluestem region. Many stockmen depend on the forest ranges for forage for their cattle — at least during part of the year. However, most of these ranges have been badly overgrazed and the forage resource greatly depleted. Our research program is aimed at helping restore and maintain the productivity of these areas.

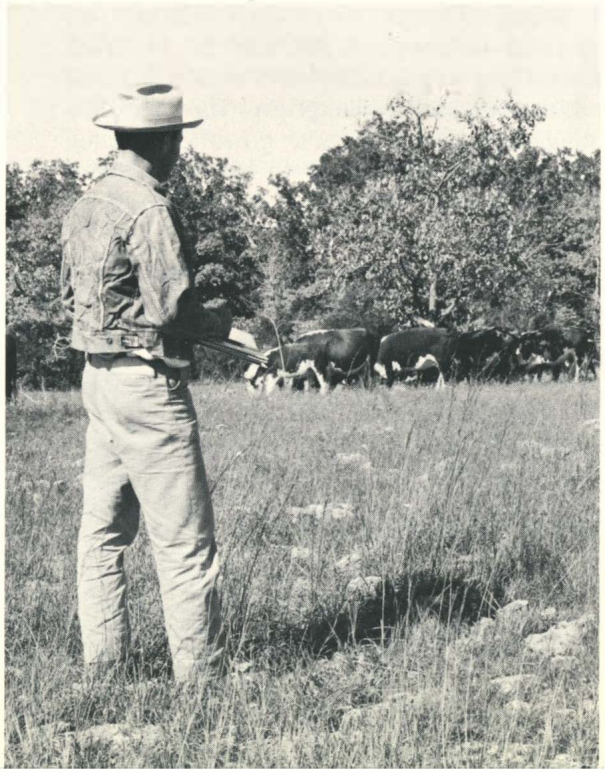
Part of our research is aimed at determining the production potential of various range sites under different circumstances. This involves studying the effect of various vegetative, climatic, and physiographic factors on forage yield.

Production of little bluestem, big bluestem, and Indiangrass was measured on excellent to poor ranges to evaluate several possible methods of determining plant vigor. We found production per square inch of basal area of stems to be a much better indicator of plant vigor than maximum leaf length, maximum seedstalk length, and number of vegetative and fertile culms.

Seedstalk production can be stimulated by increasing surface soil temperature in early spring. In the prairie forest of the western Ozarks, where litter is heavy and soil moist, the soil remains wet and cold for extended periods. Under these conditions warm season grasses, such as the bluestems and Indiangrasses shown in this prairie opening, are slow to resume growth in spring. They will, though, respond readily to higher soil temperature resulting when old vegetation is removed by mowing or burning.

We are studying the effects of kinds and numbers of animals on vegetation and the reciprocal effects of vegetation on animals. This work will give us principles and guides for developing better grazing management systems consistent with good soil and water conservation.

Forage preference and the time cattle spend grazing on typical Ozark forest ranges are strongly related to time of year and seasonal variation of forages. For instance, during mushroom season, a few weeks in late spring, cattle spend most of their time roaming the woods looking for mushrooms and very little time in the openings eating grass. Cattle activities are also influenced by terrain and land use.



Range improvement can result in heavier cattle. Calves raised on forest ranges improved by seeding (following a preparatory burning) or on forest ranges used in conjunction with an improved fescue-legume pasture weighed nearly 450 pounds at weaning compared with 350 pounds for calves from unimproved forest ranges.

The type-conversion phase of our range research program is concerned with developing methods of increasing forage on forest ranges. Our present research involves developing methods of controlling the undesirable vegetation and replacing it with desirable plants using various combinations of herbicides, fire, fertilizers, and seeding of different forage species.

1959

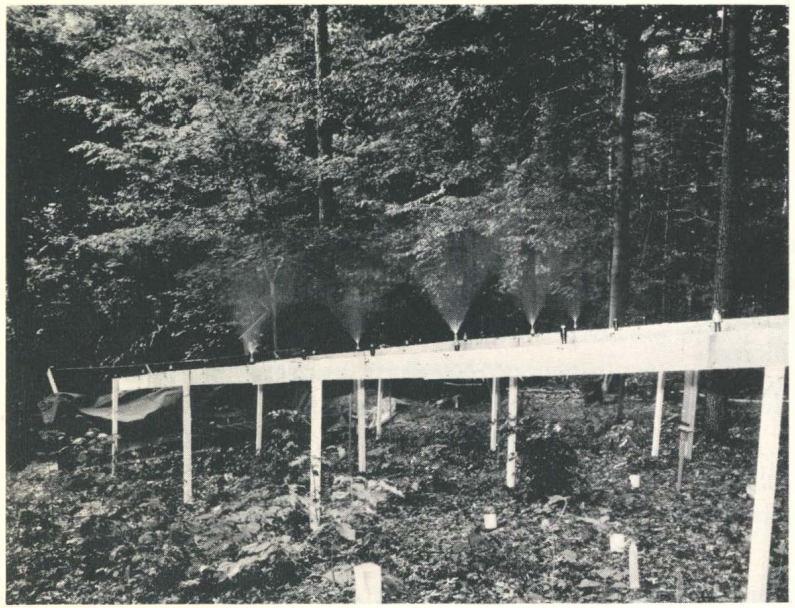
Forage production on forest ranges that have a low capacity for timber production can be greatly increased by proper treatment and management. Production on this forest range increased from 30 pounds of forage per acre before treatment in 1959 to nearly 2½ tons per acre in 1962. Treatment consisted of aerial spraying with 2,4,5-T, seeding to a fescue-legume mixture, and fertilizing.

1962

WATERSHED MANAGEMENT

The purpose of our watershed management research is to find out how to manipulate the natural water "system" so as to provide water for man's use in the amount and form he needs. Man can exert little or no influence over precipitation itself so the next best thing is to find out how to regulate the supply and flow of water after it reaches the ground.

On forested watersheds in the Central States, overland flow of water is no problem. All the water that falls on the forest floor goes into the soil. So the problem is: What happens to it then? Much of our water research is devoted to answering this question. Shown here is the most modern nuclear equipment for measuring soil moisture.



We are studying the movement of water beneath the soil surface by simulating rainfall on small plots and following the movement of the water through the soil.

Water moving through the various layers of forest soil may be retained in different amounts in different layers. Excess water in the soil gravitates in the direction of least resistance. The complex structure shown here makes it possible to measure seepage outflow occurring from various depths in the saturated profile. Preliminary results indicate that where soil moisture tension is high before and during "rains," the lowest zone overlying the water-impeding stratum must be wetted before water will flow in the upper soil zones.

This instrument shows direction of water movement, however slight.

In October 1961, we began research at our Berea, Kentucky, office on forest resource restoration and watershed management problems associated with strip mining in the Appalachian Mountains. Large areas of forest land in this Region are underlain by coal and mining on this land is expected to continue for many years.

Strip mining and augering temporarily disturb other natural resources — land, forests, and water. Such disturbances can be reduced sharply and the resources restored by re-establishing quickly a productive cover on the mined land. Our objective in this research is to find efficient, successful restoration methods and minimize the effects of harvesting mineral resources.

Collecting a water sample from a forested watershed in eastern Kentucky, where there is a coal strip mine in operation, to determine if there is any real change in water quality.

Seeding spoil banks in eastern Kentucky. A quick protective cover should help promote stabilization of coal-stripped land. Research results to date suggest that seeding of some grasses and legumes can be extended to late summer and early fall for restoring a cover shortly after mining operations.

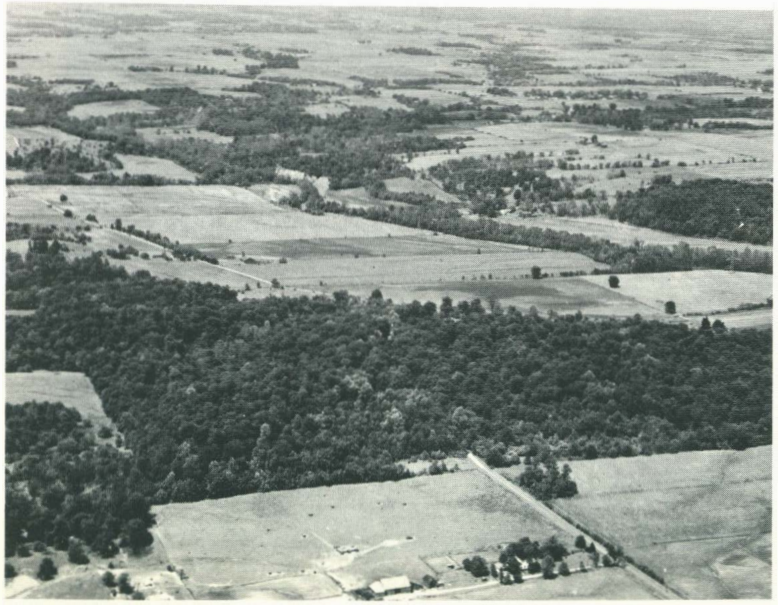
Collecting spoil sample for a greenhouse and laboratory study to determine the fertility of coal strip-mine spoils coming from different stratigraphic horizons in eastern Kentucky. Results of this research will aid in selecting plants that provide a quick cover on forest areas disturbed when harvesting coal.

Simple log culverts placed at regular intervals on temporary coal-haul roads can help carry water from road ditches into forest litter where solids are filtered out before the water reaches a stream. Culverts have greater self-cleaning properties if placed diagonally so their length across the road is 1½ times the road width.

RECREATION AND WILDLIFE

The Station's active interest in the closely related fields of recreation and wildlife habitat reflects the growing public interest in and demands for more outdoor recreational opportunities.

Because of the opportunities for private woodland owners to supply, at a profit, outdoor recreational facilities, we are concentrating our initial research efforts on the development of guides for planning and managing recreational enterprises on private woodlands.



Private woodlands like these may be the key to increasing the outdoor recreational facilities and opportunities in the Midwest.

The hardwood forests of the Central States Region supply food, cover, and breeding grounds for many of our upland game birds and animals: deer, turkey, and squirrel, to name a few. In order to develop management guides for efficient use of this resource we are first evaluating the extent, condition, and food-production characteristics of the important forest types. Along with this we are determining the relation of wildlife food production to timber stand structure, past land use, and physiography.

Forest stand density is inversely correlated with herbage and browse production. Differences in percent of crown cover and square feet of basal area account for most of the variation in production of understory vegetation among timber stands. Relatively open stands such as this one have high production of desirable game foods.

1962 PUBLICATIONS

Berry, Frederick H.
DISEASE AFFECTS WALNUTS IN MISSOURI. Missouri Forestry and Forest Industries, Ext. Serv. and School of Forestry, Univ. of Mo. May, pp. 1-2.
(The anthracnose fungus defoliating black walnut in Missouri can be controlled with zineb, bordeaux mixture, maneb, or dodine applied four times after leaves emerge.)

* Berry, F. H., and Dooling, O. J.
FOMES ANNOSUS ON SHORTLEAF PINE IN MISSOURI. Plant Disease Reporter 46(7):521-522, illus.
(This root rot was found on all of 14 thinned stands of shortleaf pine examined in southern Missouri.)

Brinkman, Kenneth A.
FERTILIZERS INCREASE SEED PRODUCTION OF SHORTLEAF PINE IN MISSOURI. Tree Planters' Notes No. 53:18-19, illus.
(Trees receiving fertilizers high in phosphorus or potassium produced about twice as many sound seeds as checks; applying fertilizers high in nitrogen also increased seed production, but not as much.)

* Buchanan, W. D., Liming, Franklin G., and Harrison, Wayne
DIAMETER GROWTH PATTERNS OF BLACK OAK TREES. Jour. Forestry 60(5):342-343.
(Dominant and codominant trees in southeast Missouri not only increase in diameter faster each month of active growth than do overtopped trees, but have a longer growing season each year because they start to leaf out and increase in diameter about 3 weeks earlier.)

Carpenter, Roswell D.
BUCKING HARDWOOD TREES FOR MAXIMUM QUALITY AND VOLUME. Northeast. Logger 11(4):16-17, 40-42, illus.
(Describes hardwood log grades and how more intensive grading could profit both forest-land owners and wood-using industries and how a specialized grading yard or operation could itself be a profitable business.)

Carpenter, Roswell D.
NEEDED — A HARDWOOD LOGGING INDUSTRY. In: Producing, harvesting, and marketing high-quality southern timber, William C. Hopkins, ed., Louisiana State University Press, Baton Rouge, pp. 93-103 (Proc. L.S.U. eleventh annual forestry symposium).
(Describes hardwood log grades and advantages of grading, also pointed out in article above.)

Central States Station
1961 ANNUAL REPORT. 57 pp., illus.
(Summarizes Station's work for 1961.)

Central States Station
VINTON FURNACE EXPERIMENTAL FOREST. 46 pp., illus.
(Describes eight demonstrations of forest management research shown to visitors: succeeds earlier brochure prepared for Sept. 17, 1959 meeting of advisory committee.)

* Central States Station and North Central Region
TIMBER MANAGEMENT GUIDE FOR UPLAND CENTRAL HARDWOODS. 33 pp., illus.

---

*Available for distribution

(Summarizes current knowledge and thinking on the management of upland central hardwoods.)

Central States Station and Southern Illinois University
1962 ANNUAL REPORT, COOPERATIVE FOREST RESEARCH PROGRAM. 25 pp., illus.
(Summarizes the program and achievements of the utilization research project during a 10-year period ending with 1962.)

Cooper, Glenn A.
HARDWOOD FOR PICNIC TABLES. National Hardwood Magazine 36(11):136, illus.
(A sturdy picnic table that meets modified National Forest standards can be built for about $30 from No. 2 Common and No. 3A Common red oak and hickory lumber using equipment found in a medium-size woodworking shop.)

* Dale, Martin E.
AN EASY WAY TO CALCULATE CROWN-SURFACE AREA. Jour. Forestry 60(11):826-827, illus.
(Formula developed shows that for cone-shaped crowns, the surface area is about 1.65 times the product of length and diameter; for paraboloid-shaped crowns, it is about 2.16 times the product.)

Dalrymple, Arlo V.
THE EFFECT OF LEAF AGE AND ABSCISSION ZONE FORMATION ON THE ABSORPTION AND TRANSLOCATION OF 2,4,5-TRICHLOROPHENOXYACETIC ACID BY BLACKJACK OAK (*Quercus marilandica* Muenchh.) (ABSTRACT). Jour. Range Management 15(1):59.
(Absorption and translocation of 2,4,5-T in blackjack oak in Oklahoma were found to be high when kill was high, being greatest in early spring, decreasing sharply in May and June, and increasing in August and September.)

Dochinger, L. S., and Seliskar, C. E.
FUSARIUM BARK CANKER OF YELLOW-POPLAR (ABSTRACT). Phytopathology 52:8.
(Abstract of speech; information provided in greater detail in Journal of Forestry article, "Fusarium canker found on yellow-poplar," by the same authors, [below].)

* Dochinger, Leon S., and Seliskar, Carl E.
FUSARIUM CANKER FOUND ON YELLOW-POPLAR. Jour. Forestry 60(5):331-333, illus.
(A fungus not previously reported on yellow-poplar, *Fusarium solani* [(Martius) Appel and Wollenweber], was repeatedly isolated from diseased trees in southern Ohio. The organism is pathogenic but does not appear to be virulent and damages only yellow-poplar weakened by unfavorable environment.)

Donley, David L.
IMPACT OF INSECTS AND DISEASES AFFECTING NURSERIES AND PLANTATIONS. U.S. Forest Service Region 9 State Nurserymen's Meeting, August 21-23, 1962, Marietta, Ohio, pp. 19-22.
(Cautions plantation and nursery managers to consider possible insect and disease problems before planting, to watch closely for outbreaks thereafter, and to consult professionals for help in control.)

Ehrenreich, John H.
THREE STEPS TO BETTER OZARK PASTURES. The Missouri Farmer 54(1):17.
(Much more grass and beef than forested pastures provide can be produced by getting rid of all trees except those needed for shade, seeding treated areas to tame grass, and fertilizing them.)

* Ehrenreich, John H., and Murphy, Dean A.
A METHOD OF EVALUATING HABITAT FOR FOREST WILDLIFE. Trans. Twenty-seventh North American Wildlife and Natural Resources Conference, March 12-14, published by Wildlife Mgt. Institute.
(Wildlife food available in forests of the Missouri Ozarks is usually greatest in seedling and sapling stands, decreases as stands grow into poletimber, and increases slightly in sawtimber. Forest type influenced both the total production of herbage and browse and its composition.)

* Funk, David T.
A REVISED BIBLIOGRAPHY OF STRIP-MINE RECLAMATION. Misc. Release 35, 19 pp.
(Lists nearly 100 references on strip-mine reclamation published since 1953 when Limstrom's original bibliography was issued plus the more than 70 technical citations that appeared in the original.)

Funk, David T.
YELLOW POPLAR SEED ORCHARD ESTABLISHMENT. U.S. Forest Service Region 9 State Nurserymen's Meeting, August 21-23, Marietta, Ohio, pp. 23-25.
(Describes seed orchards, their objectives, and budding trials for establishing a yellow-poplar seed orchard.)

* Gansner, David A.
PULPWOOD PRODUCTION & CONSUMPTION IN THE CENTRAL STATES 1961. Tech. Paper 192, 8 pp., illus.
(Pulpwood production and consumption in the Central States exceeded half a million cords in 1961, showing an increase for the seventh consecutive year.)

* Gingrich, Samuel F.
ADJUSTING SHORTLEAF PINE VOLUME TABLES FOR DIFFERENT LIMITS OF TOP UTILIZATION. Tech. Paper 190, 12 pp., illus.
(Presents a formula for adjusting shortleaf pine volume tables used in the Central States to various minimum top diameters.)

* Hay, C. John
REDUCE RED OAK BORER DAMAGE SILVICULTURALLY. Sta. Note 154.
(To be effective in control, tree poisoning must be carried out during the 1 year out of every 2 that borers are vulnerable to it — from the date of peak adult emergence, about July of odd-numbered years, to June of even-numbered years.)

* Hosner, John F., and Boyce, Stephen G.
TOLERANCE TO WATER SATURATED SOIL OF VARIOUS BOTTOMLAND HARDWOODS. Forest Science 8(2):180-186, illus. (Seedlings of 17 bottomland species were classified for tolerance to water-saturated soil.)

Kaeiser, Margaret, and Boyce, S. G.
EMBRYOLOGY OF LIRIODENDRON TULIPIFERA L. Phytomorphology 12(2):103-109, illus.
(Describes the embryology of yellow-poplar from the development of the pistil and the ovule through the processes of megasporogenesis, megametogenesis, microsporogenesis, microgametogenesis, fertilization, and embryo and endosperm development.)

* Kaeiser, Margaret, and Boyce, Stephen G.
USE OF AN INTEGRATING STAGE FOR MEASUREMENT OF WOOD. Nature 15(4845):1017.
(Reliable measurements can be obtained in less than half the time required by a microscope operator making camera lucida drawings.)

* Kucera, C. L., and Ehrenreich, John H.
SOME EFFECTS OF ANNUAL BURNING ON CENTRAL MISSOURI PRAIRIE. Ecology 43(2):334-336.
(Herbage and flower stalk production increased in the first 3 years after burning and growth began 7 to 10 days earlier each spring, but there was no significant change in mineral content of current growth.)

Lane, Richard D.
HELPING YOU GET BEST RETURN FROM YOUR WOODLAND. The Ohio Farmer 230(5):46-48, illus.
(Describes facilities and work of U.S. Forest Service in Ohio.)

* Limstrom, G. A.
FOREST PLANTING PRACTICE IN THE CENTRAL STATES. Misc. Release 34, 195 pp., illus.
(Draft of a proposed U.S.D.A. handbook on establishing tree plantations in the Central States — planting and seeding, early care, insects and disease, and suitable species by product desired, soil conditions, and state.)

* Marston, Richard B.
INFLUENCE OF VEGETATION COVER ON SOIL MOISTURE IN SOUTHEASTERN OHIO. Soil Science Society of America Proc. 26(6):605-608, illus.
(Soil moisture in the unglaciated, shallow soils of southern Ohio was measured during a 22-month period to learn the effects of cover on water yields and floods. The pine site used the most water followed by oak, brush, broomsedge, and denuded sites.)

* McCauley, Orris D., and Whittaker, James C.
BUYING PRACTICES AND MARKETS OF OHIO'S SAWMILLS 1955-1958. Sta. Note 157, 2 pp.
(Stumpage purchases provided most of the timber used by Ohio sawmills and most stumpage was paid for on a lump-sum basis.)

* Mendel, Joseph J.
TIMBER RESOURCES OF THE EASTERN OZARKS. Univ. Mo. Agr. Expt. Sta. Bul. B779. 74 pp., illus.
(Completed in 1960, this is a resurvey of forest resources of 14 eastern Ozarks counties in Missouri that were last surveyed in 1947; commercial forest land has decreased slightly because of conversion to grazing, but is still found on more than 70 percent of the area and the volumes of both sawtimber and particularly growing stock have increased significantly.)

* Mendel, Joseph J.
TRENDS IN PULPWOOD PRODUCTION AND CONSUMPTION IN THE CENTRAL STATES. Tech. Paper 188, 10 pp., illus.
(Pulpwood production and consumption in the six Central States have been steadily increasing since 1955 but the annual pulpwood cut in the region is still less than the annual growth. If the current trend continues, production in 1965 will have increased 160 percent over that of 1960.)

* Mendel, Joseph J., and Gansner, David A.
VENEER-LOG PRODUCTION AND CONSUMPTION IN THE CENTRAL STATES 1960. Tech. Paper 189, 7 pp., illus.
(Veneer-log production and consumption in the Central States have increased 12 percent in the past 2 years. Indiana has replaced Kentucky as the largest producer.)

* Mendel, Joseph J., and Kaney, David W.
COOPERAGE LOGS AND BOLTS — PRODUCTION AND CONSUMPTION IN THE CENTRAL STATES — 1960. Sta. Note 153, 2 pp., illus.
(More than 120 million board feet of cooperage timber, principally white oak, was produced in the Central States in 1960. This was 33 percent more than was produced in 1958.)

Minckler, Leon S.
SILVICULTURAL CONSIDERATIONS. The Challenges of Forestry, State University of New York College of Forestry, Syracuse; 125-132.
(Reviews problems and unanswered questions in silviculture.)

Phares, Robert E.
IMPROVING SHORTLEAF PINE SEED PRODUCTION AREAS IN MISSOURI. Second Cent. States Forest Tree Improvement Conf. Proc., Franklin Park, Ill., Oct. 12 and 13, 1960:38-41, illus.
(Suggests leaving 25 to 35 square feet basal area on seed production areas: an initial cut to 50 square feet to remove poor trees and a second cut to remove low seed producers. This treatment is based on results of an investigation of shortleaf pine seed production in Missouri by Phares and Rogers [see below].)

* Phares, Robert E., and Crosby, John S.
BASAL SPROUTING OF FIRE-INJURED SHORTLEAF PINE TREES. Jour. Forestry 60(3):204-205, illus.
(Burned shortleaf pine stands may still develop into well-stocked, merchantable stands because the majority of top-killed trees, both small and large, develop basal sprouts.)

* Phares, Robert E., and Rogers, Nelson F.
IMPROVING SHORTLEAF PINE SEED PRODUCTION IN MISSOURI. Jour. Forestry 60(5):322-324, illus.
(Seed production was increased the most in stands thinned the most, to 50 square feet basal area. It was also increased by thinning from below, by selective thinning to retain better pines, and by removal of hardwoods.)

* Rogers, Nelson F., and Phares, Robert E.
NORTHERN SEED SOURCES BEST FOR SHORTLEAF PINE PLANTINGS IN MISSOURI. Sta. Note 155, 2 pp.
(Best survival in Ozark plantings was obtained with seedlings from Missouri, Tennessee, or New Jersey seed; the poorest from Louisiana seed.)

* Pruett, Emerson W., and Gatherum, Gordon E.
CONTROL OF HERBACEOUS VEGETATION IN FOREST PLANTINGS. Iowa Acad. of Science 68:153-161, illus.
(Seedlings of white pine, jack pine, and black walnut survived and grew best on three open-field sites in east-central Iowa when weeds were controlled by cultivation and nearly as well when weeds were controlled with Garlon or a mixture of Esteron and Dowpon. These tree species survived and grew less well when treated with Simazin, Chloro IPC, or mowed and least well when treated with Vapam, or Mylone, or disked.)

Ralston, R. A.
THE SMALL WOODLAND DILEMMA. Univ. Mo. Forestry Alumni Assn., Alumni News 10(3):2-4 (processed).
(Small holdings that make up more than half the available commercial forest land must meet much of the increasing demand for wood, but the level of management does not meet the need.)

* Roach, Benjamin A.
PRACTICAL SILVICULTURE FOR CENTRAL HARDWOOD STANDS. South. Lumberman 205(2556):34-35, 38.
(Considers even-aged management through clear cutting most practical in Central Hardwoods and suggests management be limited to that required to produce the desired product, not the ideal forest.)

* Ryker, Russell A., and Minckler, Leon S.
• METHODS AND COSTS OF KILLING CULL HARDWOOD TREES. Tech. Paper 191, 9 pp., illus.
(Treating low ax frills with 2,4,5-T was the most effective and one of the cheapest of four methods tried for killing cull hardwood trees.)

* Seidel, Kenneth W., and Brinkman, Kenneth A.
MIXED OR PURE WALNUT PLANTINGS ON STRIP-MINED LAND IN KANSAS? Tech. Paper 187, 10 pp., illus.
(When planted in mixture with black locust, black walnut survival, growth, and form were impaired. When planted with other species [bur oak, sycamore, redcedar, green ash], however, walnut grew almost as well as in pure stands. Mixed plantings are recommended because they usually result in better trees.)

* Seliskar, C. E.
DISEASES OCCURRING IN CENTRAL STATES. Amer. Christmas Tree Growers' Journal 6(1):20, 57.
(Foliage diseases likely to be encountered by Christmas tree growers are briefly described.)

Vogel, Willis G.
Review of: THE GRASSES OF MISSOURI. By Clair L. Kucera. Jour. Range Management 15(3):167.
(Book review.)

* Williams, Robert D.
PHOSFON-D RETARDS HEIGHT GROWTH OF BLACK LOCUST. Tree Planters' Notes No. 51: 5-6, illus.
(Phosfon-D, evaluated as a retardant, kept black locust seedlings grown in pots to a size that was more manageable for transplanting, but was far less effective when seedlings were grown in nursery plots.)

* Williams, Robert D., and Mony, Charles C.
YELLOW-POPLAR SEEDLING YIELD INCREASED BY SEED STRATIFICATION. Jour. Forestry 60(12):878.
(Number of seedlings produced increased with number of winters seed was stratified; six times as many seedlings were produced by seed stratified 3 years as by unstratified seed.)

* Woerheide, John D., and Minckler, Leon S.
PRUNING TIME FOR SHORTLEAF PINE PLANTATIONS. Southern Lumberman 205(2561):161-162, illus.
(Pruning takes less time per tree when done in one operation rather than two, when trees are spaced closer together, and when trees to be pruned have been selected beforehand.)

* Wollerman, E. H.
THE LOCUST BORER. U.S. Dept. Agr. Forest Pest Leaflet 71, 7 pp., illus.
(Describes and evaluates the locust borer and its habits as a destroyer of black locust trees.)

* Wootten, John F.
METHOXYCHLOR: SAFE AND EFFECTIVE SUBSTITUTE FOR DDT IN CONTROLLING DUTCH ELM DISEASE. Sta. Note 156.
(Dormant season application of methoxychlor emulsified spray is recommended where bird and other wildlife mortality is an obstacle to use of DDT in controlling the bark beetle that carries Dutch elm disease.)

* Worley, David P.
PREDICTING HARDWOOD STUMPAGE PRICES FROM SALES DATA. Jour. Forestry 60(3):181-183, illus.
(Provides equations for calculating current transaction prices of mixed sawtimber from volume of an average tree and percent preferred species.)

Wray, Robert D.
Review of: WHOSE WOODS THESE ARE: THE STORY OF THE NATIONAL FORESTS. By Michael Frome. Jour. Soil and Water Conservation 17(5):226.
(Book review.)